Grout-trapped contaminants no longer free to roam

Like flies in amber, contaminants can by encased in grout to prevent their escape into the surrounding environment. The Subsurface Contaminants Focus Area within DOE's Office of Science and Technology has proven that grout can be used to halt the migration of contaminants stored in shallow burial pits. Grouting waste in place can be considered either a permanent disposal solution or a first step to a safer and easier excavation.

Since 1994, SCFA has been exploring innovative ways to deliver grout to the subsurface to lock up contaminants. In summer 1997, the focus area and other organizations (Lockheed Martin Idaho Technologies Company, the Radioactive Waste Management Complex at the Idaho National Engineering and Environmental Laboratory, and MSE-Technology Applications) jointly conducted a treatability study of jet grouting and retrieval at INEEL's Acid Pit, part of the Subsurface Disposal Area at the Radioactive Waste Management Complex. The treatability study was part of a Remedial Investigation/

Feasibility Study for a CERCLA action and followed three summers of testing at INEEL's cold test pit, during which the jet-grouting concept was proven, several techniques were investigated, and various grouting materials were tested.

Jet grouting is the injection of grout into the subsurface under high pressure, causing the grout to spread out and mix with contaminated soil and solid waste. As the grout cures, it solidifies with soil and closes up spaces between soil and solid waste. SCFA is investigating the extent to which a solid soil/grout mass can stop radioactive t and hazardous materials from leaching from buried waste sites and be considered a permanent disposal solution. Monitoring of grouted waste sites will ensure that contaminants are stabilized and are not migrating.

Grouting is also being evaluated for its contribution to easier and safer excavations. Conventional retrieval technology using off-the-shelf remote excavators for either full-pit or hot-spot retrieval can create considerable dust. Innovative grout and retrieval technology mini

mizes the spread of dust and contaminants. During cold testing at INEEL in summer 1996, two formulations of an acrylic polymer from 3M Company were evaluated. One formulation used a two-component acrylic polymer to form a soft polymer that stabilized the test area and allowed easy removal of the test area during a simulated excavation. The soft polymer, which had the consistency of wet clay, also achieved better dust control than using misting sprays and fixants. Soft polymer achieved a 91 percent reduction in airborne dust as opposed to spraying and misting, which achieved a 70 percent reduction in dust.

Hot demo at INEEL's Acid Pit

Jet grouting was put to the acid test at INEEL's Acid Pit in June 1997. First, the team tested its plan and worked out problems at soil and debris pits constructed at INEEL's cold test area before moving operations to the Acid Pit, where both liquid organic and inorganic waste (some low-level radioactivity) had been intermittently disposed offrom 1954 to 1961, with minor dumping into the early 1970s. Mercury has been identified as the contaminant of main concern. The site contains no solid waste. The test used TECT, a proprietary iron oxide-based grouting material, and included the following steps:

• Driving the injection bit into the waste and drilling down 20 feet.

• Withdrawing the drill bit while nozzles injected grout at high pressure. The optimal combination of withdrawal rate, drill rotation speed, withdrawal distance, and pressure was found to be 5 centimeters per 6 seconds, 2 revolutions of the drill bit per 5-cm step, at 6,000 psi, respectively. This action mixed the grout with the r contaminated soil.

• Continuing with the drilling and grout injection until 68 boreholes were filled, systematically covering the 14 x 14 foot area with staggered rows of holes. The drill pattern allowed for overlap to ensure the grouted coJumns merged into a solid mass of grout and soil.

• Allowing the mass to solidify into a durable, leach-resistant monolith as the grout cured. The team monitored the emplacement and curing process with in situ thermal sensors and recorded volume of injected product per hole, measurable product returns to the surface beneath the thrust block, and visible effects of the injection process on adjacent holes.

• Capping off the thrust block with a specialized concretereinforced material and recontouring the site. By filling spaces in the thrust block with concrete, the team prevented surface water from seeping into the burial site. The cap is approximately 14 inches thick and extends 51/2 feet beyond the subsurface monolith.

Safe in situ disposal Key team members wore personal monitoring equipment and regional air samplers. To minimize the spread of dust and contaminants during the drilling operation, the team used six preconstructed thrust blocks aligned to cover a 24 x 25 foot surface area of the Acid Pit. The holes cut into the thrust blocks corresponded with the planned drilling pattern. The thrust blocks formed a cap over the drilling surface. Wipers within each of the thrust blocks' holes cleaned the drill bit as it was extracted from the contaminated soil. A wind shield around the site also cut down on airborne contaminants.

The jet-grouting apparatus had a HEPA filter system, HEPA boot, and drill string shroud to assist in dust control. During drilling and grout injection, the HEPA boot was attached to a catch cup on the thrust block to seal the HEPA system. The catch cup was also attached to the HEPA boot during

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repositioning of the jet-grouting apparatus to catch drippings as the drill and nozzles were extracted from each borehole and moved to the next planned drill hole.

The team used several methods to test the safety of the grouting technique. Smear samples were taken to analyze for mercury and cesium on the drill string and on the surface of the thrust block for approximately 25 percent of the injection holes. These were compared with background smears collected before grouting begun. Spoon samples were also obtained from grout returns (pools of grout that gurgled up and collected on the surface, under the thrust block, from adjacent grouting holes). The team also monitored continuously for mercury in the air and collected HEPA filter samples at the end of grouting for mercury and cesium.

What next?

Following the emplacement of the monolith, the team performed geophysical tests to evaluate the compressive strength, durability, hydraulic conductivity, and leachability of the waste form. Tests included acoustic/seismic tomography, induced polarization, and temperature measurements. In early summer 1998, the team will collect cores from the monolith and will compare them with results from the geophysical evaluations taken earlier. The project will culminate in a report that describes the project and analyzes the results.

Gretchen Matthern, project contact, said the project has garnered some good feedback from representatives of DOE's Office of Environmental Restoration (EM-40), one of OST's customer organizations. Matthern said EM-40 folks expressed interest in the jet-grouting concept during a tour of the site last summer. She also mentioned that additional deployment opportunities exist for the technology. It is one of three technologies that INEEL site personnel are considering for a suite of treatability studies in preparation for a complete cleanup of the Subsurface Disposal Area at INEEL's Radioactive Waste Management Complex.

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